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Nitrate Removal from Water Sources VIA New Autotrophic Denitrification Process; A Review Study

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Abstract—*To remove nitrate from water several methods including ion exchange, reverse osmosis, electro dialysis, catalytic denitrification, and biological denitrification have been recommended. Among these methods, biological denitrification methods are usually more cost-effective and generally performed through autotrophic and heterotrophic. In the autotrophic denitrification, the carbon source of bacteria is carbon dioxide, carbonate as well as bicarbonate ions. Their energy source is sulfur compounds such as elemental sulfur, sulfate, thiosulfate, sulfide, HS^-, together with other compounds such as nitrite, hydrogen, and Fe^{2+}.Unlike heterotrophs, autotrophs didn't require organic compounds in order to supply carbon source. They also grow less, produce less sludge and thus are less likely to form biofilm within the pipes after treatment. Autotrophic organisms oxidize inorganic compounds utilizing liberated electron for reduction of nitrate and production of nitrogen gas. In autotrophic denitrification, using sulfur as an electron donor, alkalinity is consumed which must be supplied during the operation of process. This alkalinity is usually supplied by limestone as a bed. In autotrophic denitrification for removal of 1 g of nitrate in terms of nitrogen, 2.51 g sulfur and 4.57 g of alkalinity (in terms of calcium carbonate) are consumed and 7.54 g sulfate is produced. Production of sulfate in the presence of calcium and magnesium cations results in increased hardness. Therefore, the necessity for supplying external source of sulfur as an energy source, the necessity of supplying the required alkalinity, elevation of the sulfate concentration and water hardness in the process effluent are the major drawbacks of removing nitrate using autotrophic denitrification method with elemental sulfur.According to conducted studies, in comparison with elemental sulfur, sulfide consumes less alkalinity and through adjusting the nitrate to sulfide molar ratio, the process can be directed towards production of the final product of sulfate or elemental sulfur .In the present study with attention to two mentioned properties for sulfide, a process has been proposed providing the sulfide required for autotrophic denitrification through reducing sulfate. The aim of this research is survay of the proposed process in removing nitrate from the waters containing sulfate.*